REPORT

OF AN

INVESTIGATION OF THE FOREST CONCESSION

OF THE

BUXA TIMBER & TRADING Co., Ld.

AT RAJABHATKHAWA, NORTH BENGAL,

BY

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REPORT

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Investigation of the Forest Concession of the Buxa Timber and Trading Company, North Bengal.

SECTION I.—INDIVIDUAL TANSTUFFS.

In the following remarks applying to individual tanstuffs, only such have been dealt with as gave more or less promising preliminary indications. It has not been possible, owing to the limited facilities available on the spot, in a jungle settlement such as Rajabhatkhawa, to do practical leather tests except in a few instances. Inferences as to the probable colour of the leather produced have been drawn from such factors as the colour of the hide powder after analysis, and the precipitate obtained, for instance, with gelatine and common salt which is very similar in composition to leather itself: they can, however, only be regarded as guides and not as absolute criterions The hide powder after detannising a tannin infusion is actually leather powder, but it is tinged by the pale green present owing to the previous chroming process, and this doubtless affects many of the paler colours, to a certain extent; also the chrome may act as a mordant developing natural dyes if these are present along with the tan. Further, rough leather powder has obviously a different appearance from the smooth grain of leather itself, owing to its different behaviour to the rays of light Still it is a better criterion than the number of colour units measured by a tintometer in so far as concerns leach liquors to be applied to the hide *direct*, and not after, concentration to extract and re-solution; for a highly coloured infusion does not always impart all its colour to the hide. With regard to *extracts*, the tintometer reading is regarded as a factor of importance by the trade, but it is only of value as applied to a solution of the finished extract.

In Section II, a number of analyses are given of tanstuffs to which no reference is made in the present section, as the results were of purely negative value. On pages 26 and 27 a list of a number of products is given which on analysis proved to contain insufficient tannin to come into practical consideration A further list on pages 27 to 29 gives those products already rejected as useless on the evidence of the preliminary tests. For convenience in reference, a list is also there given of tanstuffs referred to in the present section as unsuitable for extract manufacture, but likely to be *useful* for direct application in the tannery.

Collection of tanstuffs.

The tanstuffs here dealt with comprise sundry leaves, twig-barks, mature barks and woods Speaking generally, all leaves and barks should be dried in the sun as at Maihar promptly after collection. The leaves can usually be beaten to powder after drying. Twig-bark should be removed from the branchlets by hammering these with wooden mallets in a straight line on two opposite sides when, in most instances, it can be peeled off It should then be promptly dried in the sun. The bark of boles of trees and large branches should be broken up small at once, and dried in the sun. If the bark is fibrous, it should be teased out coarsely into fibres or shreds, and then exposed to the sun. Bark should not be left on felled trees but removed at once. "Barked" logs may, as a rule, be stored for long periods without much deterioration of the tannin if kept dry. Needless to say, no such logs should find their way into a timber pool

The principles governing the selection of any tanstuff for extract manufacture will be gathered during perusal of this report, but they may be generally summarised in the necessity for an excess of tannin over soluble non-tannins This does not always apply in the case of extracts for which there is already a market, though they are known not to produce a very rich extract Fuller particulars on this subject will be found on reference to my

the "Note on the prospects of Tannin Extract manufacture in India" republished in the "Review of the Trade in Indian Hides, Skins and Leather" by A. C. McWatters, Esq., C.I.E., I.C.S., Controller (Hides), Indian Munitions Board.

It should be borne in mind that in actual practice the percentage of tannin in an extract always falls below the calculated theoretical maximum possible percentage of tannin, a figure often quoted in the following pages. In the absence of actual experience in manufacture, this figure is the nearest we can get, and given perfect conditions of concentration with no loss of tannin owing to oxidation or other causes, it would be absolutely correct.

De-colouration of extracts

I have not gone into the question of de-colourising tannin extracts in the following pages, as this did not seem to me a necessary part of my instructions from Government. Further, wherever possible, I am greatly in favour of no further de-colouration than that obtainable by the suitable blending of tanstuffs. All bleaching methods, I have hitherto tried, result in a distinct and very undesirable loss of tannin in addition to the *desired* loss of colour. On the other hand, if a sufficiently perfect method of de-colouration could be applied, *i.e.*, one in which the inevitable loss of tannin was small and accompanied by a relatively greater loss of non-tannin matter, we should then gain in the percentage of tannin in the extract, at the same time that we lost in the yield of such extract *Caeteris paribus*, extracts should be sold at prices based on the percentage of tannin they contain

INDIVIDUAL TANSTUFFS.

II.—Dilleniaceæ—

Dillenia indica—"*Chalta.*"

All parts of this tree, except the pulp of the fruit, contain some tannin, but the leaves and mature bark are the only parts containing sufficient for them to come into practical consideration. The bark and leaves give a green-black colouration with iron salts.

(*a*) *Leaves.*—The leaves yield a pale green infusion. The gelatine and common salt precipitate is a dirty white. The hide powder is coloured a greenish buff. The infusion contains a pale yellowish slime removed by filtration The high proportion of soluble non-tannins to tannin condemns this product entirely for extract manufacture, but it might be of value for direct application in a tannery, in particular if used to neutralise the reds in other tanstuffs.

(*b*) *Mature bark* —The mature bark gives a trace of precipitate with bromine water and a heavy precipitate with gelatine. It imparts a full pink colour to the hide powder, and contains a brown-orange slime removed by filtration. Its proportion of tannin to non-tannin, nearly 1 : 1, would not recommend it specially for extract manufacture, but it might be a useful tanstuff for direct tanning Judging by the indications obtained during analysis, it would probably give a pinkish leather.

XVI.—Ternstroemiaceæ—

Schima wallichii—"*Chilauni.*"

The only part of this tree. giving a useful result, was the twig-bark which contained some 13 per cent. tannin, with an equal proportion of soluble non-tannins. This proportion does not recommend the tanstuff for extract manufacture, but it would probably be useful in the tannery for direct application. The hide powder is coloured a very pale buff. The twig-bark infusion has a distinct smell of freshly made tea. When shaken up with chromed hide-powder, a permanent stiff foam is produced which can only be filtered with difficulty by hand squeezing through linen.

"*Chilauni*" *leaves* as a dye: see Section III, page 29,

XVII.—DIPTEROCARPACEÆ—

Shorea robusta—"*Sal.*"

My sample of mature *sal* bark was taken from twelve standing trees. It was teased out immediately after collection, promptly sun-dried and crushed in a wooden mortar to a coarse powder of a pale dull pink colour,—dusty and fibrous. Analysis showed it relatively richer in its proportion of tannin to non-tannin,—approximately 11 per cent. to 8 per cent.,—than any sample of *sal* bark I have previously examined, and I attribute this *solely to prompt sun-drying after collection.* Heating artificially in the air always causes development of "reds." Possibly artificial heat might be applied successfully in a vacuum, but I have had no suitable plant for trying this.

Sal powder "concentrate."

The coarse *sal* bark powder obtained by crushing was sieved through fine muslin in order to yield a fine impalpable powder on the lines of that carried in the air when dry *sal* bark is put through a disintegrator. The separation of this powder was first suggested by Mr. W. A. Fraymouth, the Director of the Tannin Research Factory, Maihar. The sample under examination yielded approximately 30 per cent. of impalpable powder having an analysis of 24 per cent. tannin on dry:—this against my previous test at Maihar with "concentrate" from *sal* bark collected in the usual manner, of 12·33 per cent. The fibrous residue was now sieved on a 10 mesh sieve. The coarse fibre remaining on the sieve was analysed, and showed 3½ per cent. tannin. The part which passed through the 10 mesh sieve contained (by calculation) 6 per cent. tannin, the original whole bark having shown 10·95 per cent. tannin. It is, therefore, obvious that the valuable portion of *sal* bark from the tannin standpoint is the "powder concentrate." With 24·01 per cent of tannin, and 13·28 per cent. of soluble non-tannins, the proportion of solid extract containing 15 per cent moisture, yielded by the air-dry "powder-concentrate" (*i.e.*, containing 10 per cent. moisture), works out at 39·48 per cent;—the yield of dry "crystals" containing 5 per cent. moisture from such air-dry "concentrate" works out at 35·33 per cent. The calculated theoretical maximum possible percentage of tannin works out at 51·73 per cent. for solid extract, and 61·17 per cent. for "crystals."

In order to obtain this powder, the *sal* bark would first require to be rough crushed (teased out), and then promptly sun-dried after which it would be passed through, say, a Carter's disintegrator, when the dust naturally separates, and is collected in a special dust-tower or dust-tunnel. The fibre may be used *qua* fibre, or as fuel. On the other hand, if the *sal* bark be extracted whole, merely rough crushed, the yield of crystals amounts to 17·7 per cent. as against 35·3 per cent. on the "concentrate." The calculated theoretical maximum possible percentage of tannin in "crystals" with 5 per cent. moisture then works out at 55·67 per cent. as against 61·17 per cent. in the case of the "concentrate," owing to a higher proportion of non-tannin extracted from the fibrous portion. It has, however, to be borne in mind that the yield of 35·3 per cent. on the powder calculates back to a yield of only 10·6 per cent. on the original bulk of whole *sal* bark which has yielded the powder:—possibly the higher maximum possible percentage of tannin may be deemed to justify (*a*) a certain loss in yield, and (*b*) the extra expense of final crushing. There can, however, be no doubt about the greater ease of manipulation of the leaches, provided *sal* bark be only rough crushed. The fine impalpable powder is not easy to mix with water, and some device for filtering-off the very finely divided matter,—possibly a bed of fine sand beneath the false bottom in the leaches,—if not this then centrifuging, or a filter-press—will probably be necessary, as it is doubtful whether this finely powdered tanstuff will efficiently settle out.

Quantity of raw material required for production of 900 tons of crystals.

(*a*) Whole bark: 5,084 tons or 137,268 maunds.

(*b*) Powder "concentrate": 2,547·4 tons or 68,780 maunds, which is the theoretical amount obtained by crushing 8,490 tons or 229,230 maunds allowing exactly 30 per cent. of powder "concentrate."

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It may be mentioned that two months after my first analysis of *sal* powder "concentrate" a second analysis of the *sal* powder was put through to determine whether there had been any deterioration owing to keeping. I was gratified to find that in the meantime there had been no deterioration in tannin strength.

Keeping qualities of promptly dried *sal* powder "concentrate."

It is probable that *sal* bark will yield an extract similar in class to *quebracho*, but less rich in tannin.

By direct tannage of a piece of thin cow-hide with rapidly sun-dried crushed *sal* bark the leather was thoroughly penetrated in nine days. The grain was a trifle drawn, but there was no vestige of crack on a double bend. The colour of the leather was pale pink as against the usual brick-red or brown-red. In character it is rather of the sole-leather type. I have noted that this leather reddens when exposed to the sun *before drying*. Nine days tannage although for a very thin piece of leather is quicker than almost any tannage I have hitherto come across where there was no form of mechanical movement of the hide or the tan liquor.

Sal leather.

Sal leather is somewhat harsh, and the extract will probably be used in conjunction with other extracts giving a softer leather, *e.g.*, *sumac* extract.

Sal twig-bark:—Twig bark of *sal* freshly collected and dried in the sun might be of some use in the tannery for direct tannage, but would be useless from the point of view of extract since my sample contained but 8 per cent. tannin to 15 per cent. soluble non-tannins. It produces a mustard coloured hide-powder, and would probably give a buff leather.

XXI.—Tiliaceæ—

Elæocarpus varunna—"*Badrasi*."

(*a*) *Leaves*:—The green leaves of *badrasi* produce a powder very similar in appearance to ground *sumac*, and having a similar smell. In its analysis the hide powder was coloured a light olive-brown shade. The high proportion of non-tannins in this tanstuff quite prevents its consideration from an extract standpoint, but it possesses some bleaching property and might be of use for direct application in the practical tannery.

(*b*) *Twig-bark*:—The powdered twig-bark has also somewhat the appearance of *sumac*, but is of a darker green shade. It imparts a greenish-buff shade to the chromed hide-powder, but this green would probably be neutralised in the practical tannery by a salmon coloured "suspended insoluble" which is also present. The proportion of tannin, 9·29 per cent. is sufficient to justify experiments with this tanstuff for direct application in the tannery, but the non-tannins are too high to admit of its coming into consideration for extract.

(*c*) *Mature bark*.—The mature bark of *badrasi* is not useful.

XXVIII.—Burseraceæ—

Garuga pinnata—"*Dabdabi*."

The twig-bark of this species with 8·88 per cent. of tannin to 14· per cent. of soluble non-tannins would only be of use in direct tannage. It gives a slightly reddish tinge of drab to the chromed hide-powder. Not being very rich in tannin, it would probably only be of use in case of shortage of richer tanstuffs.

The mature bark is still poorer in tannin, and, with 7·46 per cent. of the latter, would hardly come into consideration. It gives a pink buff to the hide powder, and would probably give a pinkish leather.

XXIX.—MELIACEÆ—

Dysoxylum binectoriferum—"*Lasuni.*"

The mature bark of this tree holds out prospects of usefulness in the manufacture of extract. It will be seen, however, from its analysis quoted in Section II, page 17 that it has the disadvantage of possessing some 12 per cent. of difficultly soluble "reds." These "reds" are extracted in the hot liquors, but settle out on cooling. The soluble non-tannins only amount to 8½ per cent., which, with the 15½ per cent. tannin will give a calculated theoretical maximum possible percentage of tannin in "crystals" with 5 per cent. moisture of 61·03 per cent. The yield of such extract, calculated on air-dry bark with 13 per cent. moisture is 22·75 per cent., assuming that the "reds" have been removed. The necessity for their complete removal, by efficient settling cannot, however, be too much insisted upon, as their presence would be wholly deleterious. A sample of younger bark of this *lasuni* was freer from "reds" but, much less rich in tannin and the proportion of tannin to non-tannins was about 1 : 1. For extract, therefore, the bark should only be collected from mature trees.

Quantity of raw material required.

An output of three tons of "crystals" per diem, during a working year of 300 days requires 3,956 tons or 106,812 maunds of mature bark.

Direct tannage.

The tannin in *lasuni* gives a green black with iron salts and a precipitate with bromine water, and so would appear to be of the catechol class, and similar in characteristics to the tannin of *quebracho*. The infusion imparts to the hide-powder a pale pink with greenish undertint. Used in direct contact tannage in the cold, by which process the "reds" are not extracted, the *lasuni* bark imparts to the leather a pale tinge of pink buff. The tannin penetrates more rapidly than almost any tannin with which I have become acquainted, and a small thin piece of calf-hide placed in a "porridge" of ground *lasuni* bark and water was completely tanned through in eight days. The leather showed a long fibre, and only tore with great difficulty, although quite a thin piece was taken. It is suggested that young *lasuni* bark, *i.e.*, from branches, etc., should be used direct in the tannery, and the mature bark collected for the manufacture of *lasuni* extract.

Amoora species—"*Lalli.*"

The mature bark with 9 per cent. tannin and 17 per cent. non-tannins only recommends itself for application in direct contact with the hide. It, however, imparts to the hide-powder only a light coral pink shade, but it is possible that the infusion owing to the presence of some orange coloured insoluble matter might give a slightly darker result on the leather in the tannery. I do not, however, anticipate very much difference, as the unfiltered hot infusion with gelatine and common salt also gives a pink.

Chukrasia tabularis—"*Chikrasi.*"

(*a*) *Leaves.*—The young leaves of this tree have a bright red colour. A sample taken from seedlings in Mr. A. K. Glasson's (Deputy Conservator of Forests, Buxa Forest Division) "nursery" at Rajabhatkhawa gave the good figures of 21·56 per cent. tannin, and 22·19 per cent. soluble non-tannins. It is true that this proportion, practically 1 : 1, scarcely recommends *chikrasi* leaves for extract, but they will probably be very useful for direct application in the tannery. The hide-powder is coloured a pale greenish buff, and *chikrasi* leaves might probably be used for the neutralisation of "reds" in other tanstuffs.

(*b*) *Bark.*—A sample taken from branch and bole of a large *chikrasi* tree gave the figures of 15 per cent. tannin to 10 per cent. soluble non-tannins, which is equivalent in "crystals" with 5 per cent. moisture, to a calculated theoretical maximum possible percentage of tannin of 56·75 per cent. The

yield of such "crystals" from air-dry bark, reckoned at 10 per cent. moisture, amounts to 23·83 per cent. This implies that for a plant to turn out 3 tons of "crystals" daily, for a working year of 300 days, 3,777 tons or 101,972 maunds will be required.

Quantity of raw material required.

Chikrasi bark colours the hide-powder pink, and would probably give a pink on the tanned hide, as the precipitate with gelatine and common salt is also pink

I understand that although *chukrasia tabularis* is a comparatively rare species, it would not be difficult to cultivate, and I commend this matter to the consideration of the Forest authorities.

Suggested special cultivation.

XXXVII.—STAPHYLEACEÆ.—

Turpinia pomifera—"*Thali.*"

The twig-bark of *thali* with approximately 6 per cent. tannin to 22 per cent. soluble non-tannins is not useful In the mature bark, tannin and non-tannins have shown themselves very nearly equal, *viz.*, 9·47 and 9 85 per cent., respectively. This does not recommend *thali* mature bark for extract, but it might be of value for practical application, direct to the hide The infusion is a full dull yellow. *Thali* produces a blue-black with iron salts, and no precipitate with bromine water. The gelatine and common salt precipitate is of a buff colour, and the hide-powder is tinged a warm brown Inference : a brown or buff-brown leather

XXXIX —SAPINDACEÆ.—

Æsculus punduana—(One of the Indian "*horse chestnuts*").

The twig-bark of this species is fairly high in tannin ;—12 42 per cent. on dry. It is, however, associated with nearly 22 per cent, non-tannins which bars the product, from an extract point of view. The twig-bark gives an orange precipitate with gelatine and common salt, and it imparts a bright orange colour to the hide powder, which would render it unsuitable in the tannery, except for special purposes where an orange coloured leather might be a desideratum. The twig-bark contains a dye, having the unusual property of fixing itself direct on cotton without a mordant. The colour produced is a salmon yellow which becomes rather pinker on soaping. The yield of "crystals" for dyeing is mentioned on page 29 in Section III,—Dyes, as 33 per cent.

(*b*) *Leaves*:—The leaves contain only some 7 per cent. tannin, and a little yellow dye, which is very inferior to that contained in the twig-bark.

XLI.—ANACARDIACEÆ.—

Odina wodier—"*Hallureh.*"

Both in the case of the twig-bark and the mature bark, *hallureh*, shows slightly more non-tannins than tannin. My sample of twig-bark shows 12 per cent. tannin, and mature bark 10¼ per cent. The hide-powder is coloured pale pink to pinky grey, and the precipitate with gelatine and common salt is a pink-white. By direct tannage, therefore, *hallureh* twig-bark or mature bark might be expected to give a pale pink leather somewhat of the type of *quebracho*. Its infusion gives a precipitate with bromine water, and its tannin would appear to be of the catechol class.

	Per cent
Yield of "crystals", from air-dry bark	20·21
Calculated theoretical maximum possible percentage of tannin	45 65

XLV.—LEGUMINOSÆ.—

Acacia catechu—"*Khair.*"

My first analyses were done on logs of girth 31", 19", and 14" respectively;—in each case the bark, the white sap-wood and the brown heart-wood were analysed. It was found that the heart-wood in the small branch was relatively richer in extract than that in the bole of the tree, but on the other hand, the small branch contained proportionately very much less heart-wood. No white spots of crystallised catechin were noticed in any of this heart-wood. Full particulars of the analyses are given in section II, pages 19-20. The following table shows the percentage yield of extract calculated on air-dry raw material with 10 per cent moisture, and allowing 15 per cent. moisture for the solid extract.

	Small log 14" girth.	Medium log 19" girth.	Big log 31" girth.
	Per cent.	Per cent.	Per cent.
Heart-wood	20·75	15·93	13·82
Sap-wood	4·48	4·27	4·00
Bark	6·89	6·73	6·97

The proportion of the heart-wood to sap-wood not only varies in the different logs, but also in different parts of the same log, only a few inches apart. It is, therefore, very difficult to express an average figure for the relative proportion of heart-wood to sap-wood. Taking at a guess an average yield of extract of 16 per cent. for the heart-wood in all sizes of log, and given complete extraction the weight of such heart-wood required for a 3-ton unit of plant per year of 300 working days=5,625 tons or roughly 1½ lakhs of maunds of heart-wood. The quantity of raw material to which this amount of heart-wood would correspond, would necessarily vary from time to time according to the size and quality of *khair* wood that was coming into the factory. Possibly, it would be safe to take it at double the amount of heart-wood.

Proportion of raw material using heart-wood alone.

In a heart-wood extract, the following table gives the calculated theoretical maximum possible percentage of tannin in a solid extract containing 15 per cent. moisture.

	Calculated theoretical maximum possible percentage of tannin.
Small sized tree	50·64
Medium sized tree	44·73
Big sized tree	47·61

In sap-wood and bark, the tannin percentage is very small, and for the manufacture of an extract to be purchased on the basis of tannin analysis, it is quite impossible to include either. I have, however, observed that both sap-wood and bark develop considerable colour during concentration, and I, therefore, suggest that these might perhaps be included where the extract is sold on the basis of dye-tests, for use as a dye, as they will increase the yield of colouring matter.

My advice would always be to remove the bark from the logs promptly after felling, or at least, as soon as they come into the factory—even if that bark is afterwards to be extracted for a dye extract.

When the bark is left on the logs, various deleterious fermentations are apt to set up between it and the sap-wood, and to destroy or at least minimise considerably, the tannin in the bark and sap-wood, if not, in the long run, in the heart-wood itself

Albizzia stipulata—"*Kala siris.*"

The mature bark of this tree would appear to be one of the most suitable for extract manufacture from the point of view of its maximum possible tannin percentage, but the red colour of the leather produced is not in its favour. In my experiments, a bright pink precipitate was obtained with gelatine and common salt, but the hide-powder was rather pale red than pink, and coupling this fact with that of the presence of difficultly soluble "reds," I should expect a reddish type of leather from the extract although its use direct, cold, in the tannery—in which case the difficultly soluble "reds" will not be extracted—would probably produce a leather of an unobjectionable pink colour. The yield of "crystals" with 5 per cent. moisture from air-dry raw material reckoned at 8 per cent. moisture would be 32 per cent. and the calculated theoretical maximum possible percentage of tannin in these "crystals" works out at 63·44 per cent. An out-turn of 900 tons,—*i.e.*, 3 tons of "crystals" per diem per working year of 300 days,—requires 2,812½ tons, or 75,937½ maunds of air-dry bark.

Quantity of raw material required

The tannin is of the catechol class and gives a heavy precipitate with bromine water

The wood of *albizzia stipulata* contains no tannin.

L.—Combretaceæ.—

Terminalia belerica—"*Bahera*" or "*Bahra.*"

The twig-bark of this species showed nearly 11 per cent. of tannin with approximately 15 per cent. of soluble non-tannins. The chromed hide-powder was coloured a yellowish shade of chestnut, and it is probable that this twig bark would be useful in direct tannage, although its high proportion of non-tannins, debars it from consideration for extract manufacture. An analysis of mine, done at Maihar, of mature bark showed only some 7 per cent. of tannin, at which proportion this mature-bark could not be useful.

The wood contains approximately 1½ per cent. tannin to 7½ per cent. of soluble non-tannins

LIII.—Lythraceæ.—

Lagerstræmia parviflora—"*Sidha*" or "*Seja.*"

Almost all parts of this tree appear to contain tannin including the wood. The tannin in each case gives a blue-black with iron salts, and no precipitate with bromine water. The infusion of the wood imparts to chromed hide-powder a colour very similar to that of the chestnuts and oaks, and in view of its similarity to the latter it occurred to me that it might probably be used not only as a "self" extract, but also in admixture with true chestnuts and oaks.

After I had convinced myself of the potential value of the wood by analyses, I put into an infusion of this wood still containing the raw material, a piece of bated hide which has tanned out very much like chestnut leather.

The following table A gives:—

(1) the percentage of tannin calculated on the dry material;

(2) the percentage of soluble non-tannins calculated on the dry material;

(3) the yield of solid extract with 15 per cent. moisture reckoned on the air-dry raw material;

(4) the calculated theoretical maximum possible percentage of tannin in such extract;

(5) the yield of "crystals" with 5 per cent. moisture calculated on the air-dry raw material;

(6) the calculated theoretical maximum possible percentage of tannin in such "crystals";

(7) the amount of raw material in tons, required to turn out 3 tons of "crystals" daily during a year of 300 working days; and

(8) the equivalent of No. (7) in maunds;—all this for the various individual parts of the *sidha* tree.

Table—A.

Description of the individual parts of the *sidha* tree.	Tannin on dry.	Soluble non-tannins on dry	Yield of extract with 15 per cent. moisture.	C. t. m p. percentage of tannin in such extract	Yield of "crystals" with 5 per cent moisture.	C. t. m p. percentage of tannin in such "crystals"	Quantity of raw material required	
	1	2	3	4	5	6	7	8
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Tons	Maunds.
Young leaves . .	16·77	15·09	33·73	44·74	30·18	50·00	2,982	80,514
Twig and small branch bark.	8·76	10·82	21·19	38·03	18·96	44·50	4,747	128,169
Mature bark . .	7·84	8·87	18·09	39·58	16·18	44·58	5,562·5	150,187·5
Mature wood . .	5·42	5·01	11·04	44·17	9·88	49·37	9,110	245,970
Twig wood .	1·56	6·71	...	...	...	...	...	...

The samples of barks and wood were all average samples. The wood was taken by sawing through 5 large logs, and 3 branch logs;—in all 15 cuts were made. The calculations of the yield of extract whether in solid block form or in "crystal" form, have been based on the air-dry raw material. This has been taken at 10 per cent. moisture in the case of the leaves and the wood, and at 8 per cent. moisture in the case of the barks. It may be mentioned that the leaves and the barks also give a more or less chestnut indication on the chromed hide-powder; perhaps a shade yellower in the case of the barks. It will be noted, however, from the foregoing table that the young leaves are the richest of all parts of the tree in extract, and yield the extract of highest maximum possible percentage of tannin, being in this respect a shade better than the wood. The young leaves give a grey precipitate with gelatine and common salt, the bark, a flesh-coloured precipitate, and the wood, a buff precipitate, but there is a relatively less difference in the colours of the hide-powder. It is important to note that the bark must be removed from the wood at once, and dried separately, or fermentations, which set up between bark and wood, will tend to destroy the tannin in the former and minimise it in the latter. Leaves must be dried at once after collection, and then beaten up small with wooden or bamboo rods, and packed pending their use in extract manufacture. Green chipt wood should be used in the leaches at once; if this is not feasible, it should be thoroughly dried in the sun before storing in godowns. Even seasoned wood should be thus dried after chipping, if at all damp.

Tannage.—A piece of thin bated cow hide tanned in a tub by direct contact tannage has shown that *sidha* tans slowly as do chestnut and oak. The tan bath had to be constantly strengthened by additions of fresh saw-dust after removal of an equal part of the spent saw-dust, but it was very difficult to use this weak tanstuff at all in direct tannage (without leaching and concentration), because of the proportionately huge bulk of the non-tannin matter, including wood fibre, etc. The hide was in the "porridge" of saw-dust and water for nearly 8 weeks (55 days), and it is evident that as with oak tannin, longer time would have given a better result For a thick hide with this tanstuff, several months would be required. The leather is, however, sufficiently finished to show its colour, and to some extent its

character. It is not absolutely free from crack on a double bend; perhaps because it is not quite sufficiently tanned through, though probably because of the poor quality of the dead hide used. It is of a greyish buff colour and close in the grain as in the case of oak and chestnut leathers.

XCVIII.—EUPHORBIACEÆ.—

Bischofia javanica—"*Kainjal.*"

The only part of this tree giving a useful result is the twig-bark. It should be removed from the twigs. by beating with a wooden mallet in a straight line on two opposite sides, after which the bark should be pealed off and rapidly dried in the sun. It gives a yield of extract in "crystals," reckoned on the air-dry raw material, of 27·55 per cent. and the calculated theoretical maximum possible percentage of tannin in such "crystals" with 5 per cent. moisture works out at 52·21 per cent. The proportion of raw material required to turn out 3 tons of "crystals" daily, during a 300-day working year would be 3,267 tons, or 88,209 maunds.

Quantity of raw material required.

Kainjal twig-bark gives a white precipitate with gelatine and common salt, and the hide powder is coloured a pink-drab to grey. The colouration of leather by this tanstuff would probably be very slight indeed.

Mallotus philippinensis.

The mature bark of this tree, with roughly 10¼ per cent. of tannin to 15½ per cent. of soluble non-tannins, suggests itself for use in the tannery, but not for extract manufacture. It contains 3 per cent. of anhydrides or "*reds*" which, however would not be extracted when leaching cold. The chromed hide-powder is coloured pink by an infusion free from these "*reds.*" *Hot*-leached liquors would doubtless give a red leather.

XCIX.—ULMACEÆ —

Trema orientalis—"*Kuyel.*"

Kuyel twig-bark with 8·24 per cent. tannin to 13·60 per cent. of soluble non-tannins does not particularly recommend itself, though it might be applied *direct in the tannery* to produce a buff coloured leather. On the other hand, a sample of *mature* bark without branch bark, gave virtually 15½ per cent. tannin to 8 per cent. of soluble non-tannins. On these figures the yield of "crystals" with 5 per cent. moisture from air-dry bark having 10 per cent. moisture works out at 22·2 per cent. The calculated theoretical maximum possible percentage of tannin in such "crystals" works out at 63·14 per cent. For a yield of 3 tons of "crystals" per diem during a working year of 300 days, 1,054 tons or 109,458 maunds of the mature bark would be required.

Quantity of raw material required.

The hide-powder was tinged a "salmon" colour. It was noticed that the infusion of *kuyel* mature bark was slightly acid in character, and exerted noticeable swelling action on the hide substance. This property would recommend it for use in admixture with tanstuff otherwise inclined to produce a harsh leather. Such tanstuffs are, wattle, mangroves, *sal*, etc. The tannin of *kuyel* gives a green-black with iron salts, and the twig bark showed a trace of precipitate with bromine, but in the case of the mature bark infusion, this was reduced to a mere cloudiness

Valuable swelling property.

CIII.—JUGLANDACEÆ —

Engelhardtia spicata—"*Mowa.*"

Both the twig-bark and mature bark of this species might be used in extract manufacture. The twig-bark with 13·16 per cent. of tannin, and 11·11 per cent. of soluble non-tannins gives a yield of "crystals" with 5 per cent

moisture of 23·50 per cent. and the calculated theoretical maximum possible percentage of tannin, is 51·52 per cent. The mature bark with 16·47 per cent. of tannin, and 14·08 per cent of soluble non-tannins, shows a yield of "crystals" with 5 per cent. moisture, of 28·94 per cent. and the calculated theoretical maximum possible percentage of tannin works out at 51·22 per cent Thus the mature bark is somewhat richer than the twig-bark, but is capable of yielding about the same tannin strength in an extract. The twig-bark gives a buff precipitate with gelatine and common salt, and the chromed hide-powder was also of a buff colour. The mature bark gives a pink precipitate with gelatine and common salt and a pink coloured hide-powder The probability is that with the collection of the bark from the whole tree,—bole and branches,—a pinky buff leather would be produced. Assuming a proportion of 3 parts of mature bark to 1 part of twig-bark, the yield of extract on the air-dry raw material for this mixture calculates to 27·58 per cent. which means that for a unit of plant to turn out 3 tons of "crystals" daily, during a year of 300 working days, 3,263 tons or 88,107 maunds of the bark would be required

Quantity of raw material required.

CVII.—FAGACEÆ.—

Oaks and Chestnuts—"*Katus.*"

In the Buxa Forest Division there are three species of this, *viz.*,—*Patle Katus* (*Quercus lanceofolia*) *Dalni Katus* (*Castanopsis indica*) and *Mushre Katus* (*Castanopsis tribuloides*). When I was at Darjeeling at christmas 1918, Mr. E. O. Shebbeare, Deputy Conservator of Forests, Kurseong, drew my attention to a book by King, which plainly showed that of the last named, five sub-varieties had been distinguished. He was able to point out to me one or two of these in the Buxa Forests. It, however, was impossible, at least for the amateur, to distinguish sub-species so closely allied, in the absence of fruit, I, therefore, decided that after having taken an average sample from different trees, it would have to be regarded as an average *mushre katus* product. Broadly speaking, I found that one could distinguish the three products as follows :—

The bark of *patle katus* peels off in long strips, is fibrous and not brittle The bark of *mushre katus* is thicker, is more brittle, and has a cellular fracture. It will not peel off in long strips The bark of *dalni katus* is not easy to distinguish from that of *mushre katus*, but, on the other hand, the leaves of *dalni katus* being enormously larger than those of either *patle* or *mushre katus*, serve to differentiate it from these species. Table "B" below gives :—

(1) Tannin on *dry* ;

(2) Soluble non-tannins on *dry* ;

(3) Yield of extract with 15 per cent. moisture from air-dry bark :

(4) the calculated theoretical maximum possible percentage of tannin in such extract ;

(5) Yield of "crystals" with 5 per cent. moisture, from air-dry bark ; and

(6) the calculated theoretical maximum possible percentage of tannin in such "crystals,"

—all for the barks.

Table "C." below gives the same for the woods.

In some cases where specially stated, an average sample of wood and bark was obtained, by sawing right through both, before the log had been de-barked.

Table—B.

Particulars.	Tannin on dry.	Soluble non-tannins on dry.	Yield of extract with 15 per cent. moisture.	C. t. m. p. percentage of tannin in such extract.	Yield of "crystals" with 5 per cent. moisture.	C. t. m. p. percentage of tannin in such "crystals."
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
(1) '*Patle katus*'—*Quercus lanceofolia* :—						
(*a*) Twig bark	9·85	14·41	25·09	34·51	22·98	38·57
(*b*) Average of upper and lower bark from several trees.	10·93	8·10	20·15	48·82	18·03	54·56
(*c*) Mature bark	8·46	9·32	19·35	39·34	17·32	43·97
(2) '*Dalni Katus*'—*Castanopsis indica* :—						
(*a*) Twig and small branch bark.	11·79	11·13	24·26	43·72	21·72	48·26
(*b*) Average of upper and lower bark.	6·10	5·21	12·76	43·24	11·36	48·30
(3) '*Mushre Katus*'—*Castanopsis tribuloides* :—						
(*a*) Twig bark	13·00	16·46	31·19	37·51	27·91	41·92
(*b*) Average of upper and lower bole bark from 6 trees.	11·60	9·65	22·50	46·40	20·13	51·86

Table—C.

Particulars.	Tannin on dry.	Soluble non-tannins on dry.	Yield of extract with 15 per cent. moisture.	C. t. m. p. percentage of tannin in such extract.	Yield of "crystals" with 5 per cent moisture.	C. t. m. p. percentage of tannin in such "crystals."
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
WOODS OF THE DIFFERENT SPECIES OF "KATUS" WITH BARK ON, AND WITH BARK REMOVED.						
(1) "*Patle Katus*"—*Quercus lanceofolia*—						
(*a*) Average sample from 5 cuts in one tree.	2·31	4·39	7·62	27·27	6·82	30·48
(*b*) Average sample from 5 small trunks.	3·37	4·04	7·85	38·66	7·02	43·21
(*c*) Average sample from 5 small trunks without removing the bark, *i.e.*, as on the tree.	3·66	5·01	9·18	35·88	8·21	40·16
(*d*) Average sample from 3 large trunks.	2·73	3·62	6·72	36·54	6·01	40·84
(*e*) Average sample from 3 large trunks without removing the bark, *i.e.*, as on the tree.	3·44	4·26	8·15	37·97	7·29	42·44
(2) "*Dalni Katus*"—*Castanopsis indica*—						
(*a*) Average sample from 2 trees.	3·06	3·44	6·89	40·02	6·16	44·72
(3) "*Mushre Katus*"—*Castanopsis tribuloides*—						
(*a*) Average sample from 6 cuts in one tree.	4·03	3·34	7·49	48·45	6·70	54·15
(*b*) Average sample of 9 logs from 3 trees ; (diam. from 7" to 19½").	4·41	2·73	7·56	52·50	6·76	58·68
(*c*) Average sample of 9 logs from 3 trees (diam. from 7" to 19½") without removing the bark ; *i.e.*, as on the tree.	5·27	3·43	9·21	51·49	8·24	57·55

Table—B.

(1) *Patle Katus bark*:—It will be seen from the above table that the yield of extract decreases from the twig-bark to mature bark, but that the mature bark is capable of producing a considerably richer extract than the twig-bark The richest extract in tannin is, however, produced by an average sample of upper and lower bark, the upper bark being taken from *large* branches, and the smaller upper parts of the bole. It will be noticed that the bark is much richer in yield than the woods (Table "C"), and also produces extracts with a higher maximum possible percentage of tannin. It is, therefore, advisable to use the bark as well as the wood of *patle katus* for extract, but it should be removed from the logs and dried separately.

(2) *Dalni Katus bark*:—The bark of twig and small branches is considerably richer in yield than that of the bole of the tree and large branches. The maximum possible percentage of tannin is about the same for either, and gives a richer extract than the wood. All bark of *dalni katus* should, therefore, be employed. It should be removed at once as in the case of *patle katus* and dried separately.

(3) *Mushre Katus bark*:—In this case the twig-bark gives a less rich extract than the mature bark, but a larger yield, and might, therefore, well be included in an extract.

Table—C—Katus wood.

(1) *Patle Katus wood*:—Comparing analyses (*b*) and (*d*) (See Table "C" above, wood without bark from *small* trunks and from *large* trunks), it will be seen that both the yield and the percentage of tannin is somewhat lower from the large trunks than from the small trunks. Comparing analyses (*c*) and (*e*), *i.e.*, woods with barks left on, the yield is again less in the case of the large trunks, but the large trunks show a somewhat higher percentage of tannin in the extract. This is owing to a common tendency of young bark to contain relatively more non-tannins. In those analyses with bark included, the figures for yield are in each case better than when the bark has been removed, and the variation in the maximum possible percentage of tannin is not sufficient to make any serious difference. Small and large trees or large branches may, therefore, quite well be employed, but it should be noted that the wood of quite small branches up to 1" diam. in the case of *patle katus* is *not* useful.

(2) *Dalni Katus wood*:—The wood of *dalni katus* does not differ largely from *patle katus* in point of yield, but my figures indicate that it is capable of producing a somewhat richer extract. Wood, however, of twigs and small branches up to 1" diam should not be used, as this is very poor in tannin and relatively high in non-tannins.

(3) *Mushre Katus wood*:—An average sample of wood from a number of trees of various sizes gives a similar yield to the other *katuses*, but is capable of producing a much richer extract—58 per cent. tannin being the calculated theoretical maximum Including the bark, the yield is a shade better than even young *patle katus* wood with bark, and the maximum possible percentage of tannin is nearly 57½ per cent. as against nearly 40 per cent. Therefore, whilst in point of yield *mushre katus* comes in much the same category as the other two *katuses*, it is nevertheless distinctly the best of the three from an extract standpoint, because capable of producing the richest extract in tannin percentage.

Katus leaves:—The mature leaves of *patle* and *mushre katus* are not useful as they are poor in tannin and contain a large preponderance of soluble non-tannins. *Patle katus*, however, puts forth long, tender, green-to-pink branchlets with a corona of young leaves, in the Buxa forests in mid-February. These shoots run about 18" to 24" in length. The whole shoot with leaves adhering may be dried and beaten up small with bamboo rods on a clean surface. Its analysis figures indicated a yield of extract in "crystals" of 41·20 per cent. on air-dry leaves, and the calculated theoretical

Patle Katus—young leaves and shoots.

X/29

maximum possible percentage of tannin works out at 46·89 per cent. This leaf-and-tender-shoot product imparts much the same colour of "chestnut" to the hide-powder, as is obtained from the other parts of the tree and considering its very high percentage yield of extract the careful collection of the young shoots during February is a matter meriting attention. It is hardly necessary to add that when collected, they should be dried promptly, and not brought into some distant factory, baled or bagged when moist and thereafter allowed to dry and wither slowly—almost certainly with fermentation—before beating to powder. Probably, similar young shoots may be produced in the case of *dalni katus*, and *mushre katus* at a particular season of the year, and if this be the case, I would commend their examination for future consideration.

Advantages of inclusion of bark in extract

I have observed that in the cases, both of *patle* and *mushre katus*—the more abundant species,—that the inclusion of the natural proportion of bark in the extract results in a clearer infusion. In the absence of bark, a liquor containing considerably more reddish—brown suspended matter is obtained. It would appear that the bark when present either removes this insoluble matter or actually prevents its formation. For this reason liquors from wood *plus* bark will be easier to manipulate and clarify before concentration. On the other hand, it is possible that the extract from wood *plus* bark may be a little more highly coloured. The proportion of bark, however, on the tree is not a very large one.

Experiments done on all the above three kinds of *katus* indicated that extraction throughout at boiling temperature gives a very inferior result. Extraction should be done as far as possible in the cold, and heat only applied at the end of the process.

Tannage.—Half a very small thin dead hide was tanned for 54 days in the sawdust of *mushre katus*. Two other pieces aggregating together about the same size, were tanned in a mixture of equal parts of *lagerstræmia parviflora* wood and *mushre katus* wood. In each of the above cases, a small proportion of the barks (10 per cent.) was used along with the woods. The pieces tanned in *mushre katus* alone and in the above mixture are almost identical in feel and colour, and require about the same proportion of tanstuff.

Katus fruits.—The fruits of the above mentioned three species of *katus* are neither sufficiently abundant nor large enough to come into consideration from the commercial standpoint, and have therefore not been investigated.

Section II.—ANALYTICAL WORK.

II.—DILLENIACEÆ—

Dillenia indica—"*Chalta*".

1. 9th February 1919.—(*i*) Leaves—

Tannin absorbed by chromed hide powder	8·71
Soluble non-tannins	18·60
Insoluble matter	72·69
	100·00

2. 9th March 1919.—(*ii*) Twig and small branch bark—

Tannin absorbed by chromed hide powder	5·27
Soluble non-tannins	13·41
Insoluble matter	81·32
	100·00

3. 29th January 1919.—(*iii*) Mature bark—

Tannin absorbed by chromed hide powder	10·32
Soluble non-tannins	10·56
Insoluble matter	79·12
	100·00

4. 24th April 1919.—(*iv*) Mature wood—

Tannin absorbed by chromed hide powder	0·74
Soluble non-tannins	3·70
Insoluble matter	95·56
	100·00

Dillenia pentagyna—"*Tatri*"

5. 12th March 1919.—(*i*) Twig and small branch bark—

Tannin absorbed by chromed hide powder	6·02
Soluble non-tannins	16·52
Insoluble matter	77·46
	100·00

6. 12th January 1919.—(*ii*) Mature bark—

Tannin absorbed by chromed hide powder	6·22
Soluble non-tannins	14·50
Insoluble matter	79·28
	100·00

7. 28th January 1919.—(*iii*) Mature wood—

Tannin absorbed by chromed hide powder	1·63
Soluble non-tannins	2·81
Insoluble matter	95·56
	100·00

XVI.—TERNSTRŒMIACEÆ—

Schima wallichii—"*Chilauni*".

8. 17th March 1919.—(*i*) Leaves—

Tannin absorbed by chromed hide powder	4·32
Soluble non-tannins	17·37
Insoluble matter	78·31
	100·00

9. 17th March 1919.—(*ii*) Twig bark—

Tannin absorbed by chromed hide powder	13·23
Soluble non-tannins	13·25
Insoluble matter	73·52
	100·00

10. 15th January 1919.—(*iii*) Mature bark—

Tannin absorbed by chromed hide powder	6·36
Soluble non-tannins	8·33
Insoluble matter	85·31
	100·00

11. 2nd February 1919.—(*iv*) Wood—

Tannin absorbed by chromed hide powder	1·64
Soluble non-tannins	2·53
Insoluble matter	95·83
	100·00

XVII.—DIPTEROCARPACEÆ—

Shorea robusta—"*Sal*".

12. 20th April 1919.—(*i*) Twig bark—

Tannin absorbed by chromed hide powder	8·11
Soluble non-tannins	15·00
Insoluble matter	76·89
	100·00

13. 19th February 1919.—(*ii*) Mature bark—

Tannin absorbed by chromed hide powder	10·95
Soluble non-tannins	7·74
Insoluble matter	81·31
	100·00

14. 23rd February 1919.—(*iii*) Powder "concentrate" of No. (*ii*)—

Tannin absorbed by chromed hide powder	24·01
Soluble non-tannins	13·28
Insoluble matter	62·71
	100·00

15. 28th February 1919.—(*iv*) Fibrous portion of No. (*ii*)—

Tannin absorbed by chromed hide powder	3·78
Soluble non-tannins	6·34
Insoluble matter	89·88
	100·00

XIX.—MALVACEÆ—

Bombax malabaricum—"*Simal.*"

16. 24th April 1919.—(*i*) Twig bark—

Tannin absorbed by chromed hide powder	4·71
Soluble non-tannins	15·26
Insoluble matter	80·03
	100·00

17. 16th February 1919.—(*ii*) Mature bark—

Tannin absorbed by chromed hide powder	3·51
Soluble non-tannins	11·55
Insoluble matter	84·94
	100·00

XX.—STERCULIACEÆ—

Sterculia villosa—"*Udal.*"

18. 15th January 1919.—(*i*) Mature bark—

Tannin absorbed by chromed hide powder	0·84
Soluble non-tannins	6·40
Insoluble matter	92·76
	100·00

XXI.—TILIACEÆ—

Elæocarpus varunna—"*Badrasi*".

19. 12th March 1919.—(*i*) Leaves—

Tannin absorbed by chromed hide powder	9·99
Soluble non-tannins	21·19
Insoluble matter	68·82
	100·00

20. 16th February 1919.—(*ii*) Twig bark—

Tannin absorbed by chromed hide powder	9·29
Soluble non-tannins	12·51
Insoluble matter	78·20
	100·00

21. 12th January 1919.—(*iii*) Mature bark—

Tannin absorbed by chromed hide powder	2·73
Soluble non-tannins	6·71
Insoluble matter	90·56
	100·00

XXVIII—BURSERACEÆ—

Garuga pinnata—"*Dabdabi*".

22. 20th April 1919.—(*i*) Twig bark—

Tannin absorbed by chromed hide powder	8·88
Soluble non-tannins	14·38
Insoluble matter	76·74
	100·00

23. 15th January 1919.—(*ii*) Mature bark—

Tannin absorbed by chromed hide powder	7·46
Soluble non-tannins	17·17
Insoluble matter	75·37
	100·00

XXIX.—MELIACEÆ—

Dysoxylum binectariferum—"*Lasuni*."

24. 8th April 1919.—(*i*) Bark from young tree—

Tannin absorbed by chromed hide powder	9·69
Soluble non-tannins	9·03
Insoluble matter	81·28
	100·00

25. 26th January 1919.—(*ii*) Mature bark—

Tannin absorbed by chromed hide powder	15·43
Soluble non-tannins	8·59
Difficultly soluble "Reds"	12·34
Insoluble matter	63·64
	100·00

Chisocheton paniculatus.—This is often called "*Lasuni*" but is distinguishable from *Dysoxylum binectariferum* by its big fruit.

26. 12th March 1919.—(*i*) Twig and small branch bark—

Tannin absorbed by chromed hide powder	5·11
Soluble non-tannins	19·58
Insoluble matter	75·31
	100·00

27. 8th April 1919.—(*ii*) Mature Bark—

Tannin absorbed by chromed hide powder	2·31
Soluble non-tannins	23·37
Insoluble matter	74·32
	100·00

Amoora rohituka.

28. 8th April 1919.—(*i*) Bark—

Tannin absorbed by chromed hide powder	1·17
Soluble non-tannins	13·16
Insoluble matter	85·67
	100·00

Amoora species,—"*Lalli*".

29. 24th April 1919.—(*i*) Twig-bark—

Tannin absorbed by chromed hide powder	5·89
Soluble non-tannins	18·16
Insoluble matter	75·95
	100·00

30. 12th January 1919.—(*ii*) Mature bark—

Tannin absorbed by chromed hide powder	9·06
Soluble non-tannins	17·26
Insoluble matter	73·68
	100·00

31. 2nd February 1919.—(*iii*) Wood—

Tannin absorbed by chromed hide powder	2·60
Soluble non-tannins	8·62
Insoluble matter	93·78
	100·00

Chukrasia tabularis.—"*Chikrasi*".

32. 5th February 1919.—(*i*) Young red leaves—

Tannin absorbed by chromed hide powder	21·56
Soluble non-tannins	22·19
Insoluble matter	56·25
	100·00

33. 9th February 1919.—(*ii*) Bole and branch bark—

Tannin absorbed by chromed hide powder	15·03
Soluble non-tannins	10·13
Insoluble matter	74·84
	100·00

XXXVII.—STAPHYLEACEÆ—

Turpinia pomifera.—"*Thale*".

34. 9th March 1919.—(*i*) Twig bark—

Tannin absorbed by chromed hide powder	5·98
Soluble non-tannins	21·90
Insoluble matter	72·12
	100·00

35. 2nd February 1919.—(*ii*) Mature bark—

Tannin absorbed by chromed hide powder	9·47
Soluble non-tannins	9·85
Insoluble matter	80·68
	100·00

36. 23th January 1919.—(*iii*) Wood—

Tannin absorbed by chromed hide powder	0·53
Soluble non-tannins	5·10
Insoluble matter	94·37
	100·00

XXXIX.—SAPINDACEÆ—

Aesculus punduana (one of the Indian *horse chestnuts*).

37. 20th March 1919.—(*i*) Leaves—

Tannin absorbed by chromed hide powder	7·29
Soluble non-tannins	17·86
Insoluble matter	74·85
	100·00

38. 20th March 1919.—(*ii*) Twig-bark—

Tannin absorbed by chromed hide powder	12·42
Soluble non-tannins	21·87
Insoluble matter	65·71
	100·00

XLI.—ANACARDIACEÆ—

Odina wodier—"*Ballurah*".

39. 20th March 1919.—(*i*) Twig bark—

Tannin absorbed by chromed hide powder	12·10
Soluble non-tannins	13·21
Insoluble matter	74·69
	100·00

40. 12th January 1919.—(*ii*) Mature bark—

Tannin absorbed by chromed hide powder	10·25
Soluble non-tannins	11·09
Insoluble matter	78·66
	100·00

XLV.—LEGUMINOSÆ—

Spatholobus roxburghii.—"*Debri Lahra*" (a creeper)

41. 16th February 1919—(*i*) Woody stem—

Tannin absorbed by chromed hide powder	2·86
Soluble non-tannins	16·25
Insoluble matter	80·89
	100·00

Acacia catechu—"*Khair*."

42. 20th December 1918.—(*i*) Bark of small branch—

Tannin absorbed by chromed hide powder	1·75
Soluble non-tannins	4·75
Insoluble matter	93·50
	100·00

43. 17th December 1918—(*ii*) Bark of medium sized tree—

Tannin absorbed by chromed hide powder	1·80
Soluble non-tannins	4·66
Insoluble matter	93·54
	100·00

44. 17th December 1918—(*iii*) Bark from big tree—

Tannin absorbed by chromed hide powder	1·61
Soluble non-tannins	4·97
Insoluble matter	93·42
	100·00

45. 17th December 1918—(*iv*) Outer white wood of small branch—

Tannin absorbed by chromed hide powder	0·86
Soluble non-tannins	3·37
Insoluble matter	95·77
	100·00

46. 14th December 1918—(*v*) Outer white wood of medium sized tree—

Tannin absorbed by chromed hide powder	0·66
Soluble non-tannins	3·39
Insoluble matter	95·95
	100·00

47. 14th December 1918—(*vi*) Outer white wood of hole of tree—

Tannin absorbed by chromed hide powder	0·59
Soluble non-tannins	3·18
Insoluble matter	96·23
	100·00

48. 17th December 1918—(*vii*) Inner heart wood of small branch—

Tannin absorbed by chromed hide powder	11·67
Soluble non-tannins	7·92
Insoluble matter	80·41
	100·00

49. 14th December 1918.—(*viii*) Inner heart wood of medium sized tree—

Tannin absorbed by chromed hide powder	7·92
Soluble non-tannins	7·13
Insoluble matter	84·95
	100·00

50. 14th December 1918.—(*ix*) Inner heart-wood of bole of tree—

Tannin absorbed by chromed hide powder	7·31
Soluble non-tannins	5·74
Insoluble matter	86·95
	100·00

51. 8th April 1919.—(*x*) Average sample of whole log, with bark, heart-wood and sap wood—

Tannin absorbed by chromed hide powder	4·19
Soluble non-tannins	5·77
Insoluble matter	90 04
	100·00

Albizzia procera.—"*Safed Siris*."

52. 20th January 1919.—(*i*) Mature bark—

Tannin absorbed by chromed hide powder	2·75
Soluble non-tannins	7·29
Insoluble matter	89·96
	100·00

Albizzia stipulata.—"*Kala Siris*."

53. 15th January 1919.—(*i*) Mature bark—

Tannin absorbed by chromed hide powder	22·07
Soluble non-tannins	10·98
Insoluble matter	66·95
	100·00

L. COMBRETACEÆ—

Ter minalia belerica.—"*Bahera*" or "*Bahra*".

54. 20th March 1919.—(*i*) Twig bark—

Tannin absorbed by chromed hide powder	10·85
Soluble non-tannins	15·23
Insoluble matter	73·92
	100·00

55. 26th January 1919.—(*ii*) wood—

Tannin absorbed by chromed hide powder	1·42
Soluble non-tannins	7·47
Insoluble matter	91·11
	100·00

LI. MYRTACEÆ—

Eugenia formosa—"*Amboken*".

56. 9th February 1919.—(*i*) Mature bark—

Tannin absorbed by chromed hide powder	4·49
Soluble non-tannins	9·05
Insoluble matter	86·46
	100·00

LIII. LYTHRACEÆ—

Lagerstræmia parviflora—"*Siaha*" or "*Seja*"

57 20th April 1919.—(*i*) Young leaves—

Tannin absorbed by chromed hide powder	16·77
Soluble non-tannins	15·09
Insoluble matter	68·14
	100·00

58. 9th March 1919.—(*ii*) Twig and small branch bark—

Tannin absorbed by chromed hide powder	8·76
Soluble non-tannins	10·82
Insoluble matter	80·42
	100·00

59. 17th March 1919.—(*iii*) Twig Wood—

Tannin absorbed by chromed hide powder	1·59
Soluble non-tannins	6·71
Insoluble matter	91·70
	100·00

60. 20th January 1919.—(*iv*) Mature bark—

Tannin absorbed by chromed hide powder	7·84
Soluble non-tannins	8·87
Insoluble matter	83·29
	100·00

61. 26th January 1919.—(*v*) Wood—

Tannin absorbed by chromed hide powder	5·42
Soluble non-tannins	5·01
Insoluble matter	89·57
	100·00

LXI.—RUBIACEÆ—

Anthocephalus cadamba—"*Kadam*"

62. 29th January 1919.—(*i*) Mature bark—

Tannin absorbed by chromed hide powder	2·87
Soluble non-tannins	12·32
Insoluble matter	84·81
	100·00

XCVIII—EUPHORBIACEÆ—

Bischofia javanica—"*Kainjal*".

63. 12th March 1919.—(*i*) Leaves—

Tannin absorbed by chromed hide powder	6·83
Soluble non-tannins	20·96
Insoluble matter	72·21
	100·00

64. 9th March 1919—(*ii*) Twig and small branch bark—

Tannin absorbed by chromed hide powder	15·98
Soluble non-tannins	13·10
Insoluble matter	70·92
	100·00

65. 23rd January 1919.—(*iii*) Mature bark—

Tannin absorbed by chromed hide powder	6·39
Soluble non-tannins	19·44
Insoluble matter	74·17
	100·00

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66. 2nd February 1919.—(*iv*) Wood—

Tannin absorbed by chromed hide powder	2·64
Soluble non-tannins	4·92
Insoluble matter	92·44
	100·00

Mallotus philippinensis.

67. 13th February 1919.—(*i*) Bark—

Tannin absorbed by chromed hide powder	10·23
Soluble non-tannins	15·48
Difficultly soluble "Reds"	3·06
Insoluble matter	71·23
	100·00

"*Mallata*"—Macaranga species.*

68. 23rd January 1919.—(*i*) Mature bark—

Tannin absorbed by chromed hide powder	2·65
Soluble non-tannins	10·75
Insoluble matter	86·60
	100·00

XCIX.—ULMACEÆ—

Trema orientalis—"*Kuyel*".

69. 5th February 1919.—(*i*) Leaves of small tree—

Tannin absorbed by chromed hide powder	5·77
Soluble non-tannins	17·27
Insoluble matter	76·96
	100·00

70. 5th February 1919.—(*ii*) Twig bark—

Tannin absorbed by chromed hide powder	8·24
Soluble non-tannins	13·60
Insoluble matter	78·16
	100·00

71. 5th February 1919.—(*iii*) Bole and branch bark (mixed)—

Tannin absorbed by chromed hide powder	12·80
Soluble non-tannins	8·30
Insoluble matter	78·90
	100·00

72. 8th January 1919.—(*iv*) Mature bark (sample from Mr. Shebbeare, Deputy Conservator of Forests, Kurseong Division, Sukna).—

Tannin absorbed by chromed hide powder	15·58
Soluble non-tannins	7·86
Insoluble matter	76·56
	100·00

CIII.—JUGLANDACEÆ—

Engelhardtia spicata—"*Mowa*".

73. 17th March 1919.—(*i*) Twig bark—

Tannin absorbed by chromed hide powder	13·16
Soluble non-tannins	11·11
Insoluble matter	75·73
	100·00

* Probably a different species of Macaranga from the one which at Maihar gave a good proportion of tannin to non-tannin.

74. 5th January 1919.—(*ii*) Mature bark—

Tannin absorbed by chromed hide powder	16·47
Soluble non-tannins	14·08
Insoluble matter	69·45
	100·00

75. 24th April 1919.—(*iii*) Wood—

Tannin absorbed by chromed hide powder	2·34
Soluble non-tannins	5·81
Insoluble matter	91·85
	100·00

CVII.—FAGACEÆ—

OAKS.

Quercus lineata—"*Phalat*".

76. 13th February 1919.—(*i*) Mature wood—

Tannin absorbed by chromed hide powder	1·55
Soluble non-tannins	4·34
Insoluble matter	94·11
	100·00

Quercus lanceæfolia—"*Patle Katus*."

77. 19th February 1919.—(*i*) Young tender leaves and shoots—

Tannin absorbed by chromed hide powder	21·47
Soluble non-tannins	22·02
Insoluble matter	56·51
	100·00

78. 23rd February 1919.—(*ii*) Mature leaves—

Tannin absorbed by chromed hide powder	5·87
Soluble non-tannins	18·21
Insoluble matter	75·92
	100·00

79. 19th February 1919.—(*iii*) Twig bark—

Tannin absorbed by chromed hide powder	9·85
Soluble non-tannins	14·41
Insoluble matter	75·74
	100·00

80. 19th February 1919.—(*iv*) Mature bark—

Tannin absorbed by chromed hide powder	8·46
Soluble non-tannins	9·82
Insoluble matter	81·72
	100·00

81. 28th February 1919.—(*v*) Branch wood—

Tannin absorbed by chromed hide powder	0·68
Soluble non-tannins	5·99
Insoluble matter	93·33
	100·00

82. 5th January 1919.—(*vi*) Wood—5 saw-cuts in one tree—

Tannin absorbed by chromed hide powder	3·31
Soluble non-tannins	4·89
Insoluble matter	92·80
	100·00

83. 8th January 1919.—(*vii*) Sample No. (*vi*) ;—extraction at the boil—

Tannin absorbed by chromed hide powder	1·79
Soluble non-tannins	5·34
Insoluble matter	92·87
	100·00

84. 15th April 1919.—(*viii*) Average sample big logs, with bark, heartwood and sapwood—

Tannin absorbed by chromed hide powder	3·44
Soluble non-tannins	4·26
Insoluble matter	92·30
	100·00

85. 15th April 1919.—(*ix*) Average sample big logs, without bark—

Tannin absorbed by chromed hide powder	2·73
Soluble non-tannins	3·62
Insoluble matter	93·65
	100·00

86. 15th April 1919.—(*x*) Average sample small logs, with bark, heartwood and sap-wood—

Tannin absorbed by chromed hide powder	3·66
Soluble non-tannins	5·01
Insoluble matter	91·33
	100·00

87. 15th April 1919.—(*xi*) Average sample small logs, without bark—

Tannin absorbed by chromed hide powder	3·37
Soluble non-tannins	4·04
Insoluble matter	92·59
	100·00

CHESTNUTS.

Castanopsis Indica—"*Dainé Katus.*"

88. 13th February 1919.—(*i*) Twig and small branch bark—

Tannin absorbed by chromed hide powder	11·79
Soluble non-tannins	11·13
Insoluble matter	77·08
	100·00

89. 20th December 1918.—(*ii*) Average of upper and lower bark—

Tannin absorbed by chromed hide powder	6·10
Soluble non-tannins	5·89
Insoluble matter	88·01
	100·00

90. 13th February 1919.—(*iii*) Wood—average of twig-wood and small branch wood—

Tannin absorbed by chromed hide powder	2·00
Soluble non-tannins	6·00
Insoluble matter	92·00
	100·00

91. 5th January 1919.—(*iv*) Wood—average of upper and lower wood—

Tannin absorbed by chromed hide powder	3·06
Soluble non-tannins	3·44
Insoluble matter	93·50
	100·00

92. 8th January 1919.—(*v*) Sample (*iv*) with extraction at the boil—

Tannin absorbed by chromed hide powder	2·44
Soluble non-tannins	3·64
Insoluble matter	93·92
	100·00

Castanopsis tribuloides—"*Mushre Katus*".

93. 28th February 1919.—(*i*) Mature leaves—

Tannin absorbed by chromed hide powder	6·47
Soluble non-tannins	19·24
Insoluble matter	74·29
	100·00

94. 28th February 1919—(*ii*) Twig bark—

Tannin absorbed by chromed hide powder	13·00
Soluble non-tannins	16·46
Insoluble matter	70·54
	100·00

95. 20th December 1918.—(*iii*) Mature bark—

Tannin absorbed by chromed hide powder	11·60
Soluble non-tannins	9·65
Insoluble matter	78·75
	100·00

96. 5th January 1919.—(*iv*) Wood : saw-dust from six cuts in one tree—

Tannin absorbed by chromed hide powder	4·03
Soluble non-tannins	3·04
Insoluble matter	92·93
	100·00

97. 8th January 1919.—(*v*) Sample No. (*iv*) with extraction at the boil—

Tannin absorbed by chromed hide powder	3·95
Soluble non-tannins	3·17
Insoluble matter.	92·88
	100·00

98. 28th April 1919.—(*vi*) Wood—average sample from nine logs in three trees—

Tannin absorbed by chromed hide powder	4·41
Soluble non-tannins	2·73
Insoluble matter	92·86
	100·00

99. 28th April.—(*vii*) Wood—average sample from nine logs in three trees :—with heartwood, sap-wood and also bark, in the proportion on tree.

Tannin absorbed by chromed hide powder	5·27
Soluble non-tannins	3·43
Insoluble matter	91·30
	100·00

Tanstuffs too high in their proportion of soluble non-tanuin matter to be useful in extract manufacture, *but likely to be of value for direct application in the tannery* :—

	Remarks.
II.—DILLENIACEÆ—	
Dillenia indica—"*Chalta.*"—Leaves and mature bark.	*Leaves*—greenish buff leather ; might counteract "*Reds*".
XVI.—TERNSTRŒMIACEÆ—	
Schima wallichii—"*Chilauni.*"—Twig bark.	
XVII.—DIPTEROCARPACEÆ—	
Shorea robusta—"*Sal.*"—Twig bark.	
XXI.—TILIACEÆ—	
Elæocarpus varunna—"*Badrasi.*"—Leaves and twig bark.	*Leaves*—somewhat bleaches "*Reds*".
XXVIII.—BURSERACEÆ—	
Garuga pinnata—"*Dabdabi.*"—Twig bark.	
XXIX.—MELIACEÆ—	
Dysoxylum binectariferum—"*Lasuni.*"—Bark of young branches.	
Amoora species—"*Lalli.*"—Mature bark.	
Chukrasia tabularis—"*Chikrasi.*"—Young red leaves.	
XXXVII.—STAPHYLEACEÆ—	
Turpinia pomifera—"*Thali.*"—Mature bark.	
XXXIX.—SAPINDACEÆ—	
Æsculus punduana—one of the "Indian horse chestnuts."—Twig bark.	Orange-coloured leather.
XLI.—ANACARDIACEÆ—	
Odina wodier—"*Hallureh.*"—Twig bark and mature bark.	
L.—COMBRETACEÆ—	
Terminalia belerica—"*Bahera.*"—Twig bark.	Chestnut-coloured leather.
XCVIII.—EUPHORBIACEÆ—	
Mallotus philippinensis.—Bark.	
XCIX.—ULMACEÆ—	
Trema orientalis—"*Kuyel.*"—Twig bark.	
CVII.—FAGACEÆ—	
Quercus lanceofolia—"*Patle Kaćus,*"—Twig bark.	
Castanopsis tribuloides—"*Mushre Katus.*"—Twig bark.	

Negative Results.

A.—Forest products not found useful upon analysis :—

II.—DILLENIACEÆ—

Dillenia indica—"*Chalta.*"—Twig bark and wood.

Dillenia pentagyna—"*Tatri.*"—Twig and small branch bark ; mature bark and wood.

XVI.—TERNSTRŒMIACEÆ—

Schima wallichii—"*Chilauni.*"—Leaves and wood.

XIX.—MALVACEÆ—

Bombax malabaricum—"*Simal.*"—Twig bark and mature bark.

XX.—STERCULIACEÆ—

Sterculia villosa—" *Udal.*"—Mature bark.

XXI.—TILIACEÆ—

Elæocarpus varunna—" *Badrasi.*"—Mature bark.

XXIX.—MELIACEÆ—

Amoora species—" *Lalli.*"—Twig bark and wood.

XXXVII.—STAPHYLEACEÆ—

" *Turpinia pomifera*—" *Thali.*"—Twig bark and wood.

XXXIX.—SAPINDACEÆ—

Æsculus punduana—Leaves.

XLV.—LEGUMINOSÆ—

Spatholobus roxburghii—" *Debri Lahra.*"—Woody stem of the creeper.

Albizzia procera—" *Safed Siris.*"—Mature bark.

L.—COMBRETACEÆ—

Terminalia belerica—" *Bahera.*"—Wood.

LI.—MYRTACEÆ—

Eugeniaformosa—" *Amboken.*"—Mature bark.

LXI.—RUBIACEÆ—

Anthocephalus cadamba—" *Kadam.*"—Mature bark.

XCVIII.—EUPHORBIACEÆ—

Bischofia javanica—" *Kainjal.*"—Leaves, mature bark and wood.

Macaranga species—" *Mallatah.*"—Mature bark.

Another " *Mallatah* " tested by me at Maihar gave quite a good result, but it was probably not the same species of Macaranga.

XCIX.—ULMACEÆ—

Trema orientalis—" *Kuyel.*"—Leaves.

CVII.—FAGACEÆ—

Quercus lineata—" *Phalat.*"—Mature wood.

Quercus lanceofolia—" *Patle Katus.*"—Mature leaves and small branch wood.

Castanopsis indica—" *Dalni Katus.*"—Twig and small branch wood.

Castanopsis tribuloides—" *Mushre Katus.*"—Mature leaves.

Negative Results.

B.—Forest products already rejected as useless on the evidence of the preliminary tests :—

II.—DILLENIACEÆ—

Dillenia indica—" *Chalta.*"—Fruit: small indication of tannin.

III.—MAGNOLIACEÆ—

Michelia champaca—" *Champ.*"—No tannin in leaves, twig-bark or mature bark.

XIX.—MALVACEÆ—

Bombax malabaricum—" *Simal.*"—Leaves and wood : no tannin.

XXI.—TILIACEÆ—

Elæocarpus varunna—" *Badrasi.*"—Wood : trace of tannin.

XXV—RUTACEÆ—

Zanthoxylum species—" *Timur.*"—Bark and wood : no tannin.

XXVIII—BURSERACEÆ—

Garuga pinnata—"*Dabdabi.*"—Leaves and wood : no tannin.

XXIX—MELIACEÆ—

Dysoxylum binectariferum—"*Lasuni.*"—Leaves : very little tannin.

Amoora species—"*Lalli.*"—Leaves : no tannin at all.

Cedrela toona "*Toon.*"—Leaves, twig bark, and mature bark : no tannin.

XXXVII.—STAPHYLEACEÆ—

Turpinia pomifera—"*Thali.*"—Leaves : trace of tannin.

XL.—SABIACEÆ—

Meliosma simplicifolia—"*Patpati.*"—Leaves, twig bark, and mature bark : no tannin.

XLI—ANACARDIACEÆ—

Odina wodier—"*Hallureh.*"—Wood : small amount of tannin.

XLV.—LEGUMINOSÆ—

Albizzia procera—"*Safed Siris.*"—Wood : no tannin.

Albizzia stipulata—"*Kala Siris.*"—Wood : no tannin.

LI.—MYRTACEÆ—

Eugenia formosa—"*Ambokeh.*"—Leaves, no tannin ; twig bark : very little tannin.

LIV.—SAMYDACEÆ—

Casearia vareça—Leaves and twig bark : trace of tannin. Wood : no tannin.

LXI.—RUBIACEÆ—

Anthocephalus cadamba—"*Kadam.*"—Leaves : no good sample obtainable ; twig bark : small amount of tannin.

LXXX.—BIGNONIACEÆ—

Stereospermum chelonoides—"*Parari.*"—Twig bark and mature bark : no tannin.

Oroxylum indicum—Fruit and mature bark : no tannin.

LXXXI.—ACANTHACEÆ—

Phlogacanthus thyrsiflorus—Leaves and twig-bark : no tannin.

LXXXII.—VERBENACEÆ—

Clerodendron infortunatum—(a shrub) : —no tannin in any part.

Gmelina arborea—"*Gumali.*"—Leaves and bark : no tannin.

Premna bengalensis—"*Gineri.*"—Leaves and bark : no tannin.

XCI.—LAURACEÆ—

Machilus gamblei—"*Soom.*"—Bark : small amount of tannin.

Actinodaphne obovata—"*Ranchipat.*"—Leaves, twig bark and mature bark : no tannin.

Litsea sebifera—"*Kaula*"—Leaves and wood : no tannin. Bark is so intensely gummy that manipulation in tannin analysis is quite impossible as it cannot be filtered through any medium.

Litsea polyantha—"*Patmero.*"—Wood : no tannin. Bark : same as "*Kaula*" bark [*Litsea sebifera* (above)].

XCVIII—EUPHORBIACEÆ—

Croton species (local)—Bark and wood : no tannin ; leaves : trace of tannin ; autumnal red leaves contain a yellow dye.

Trewia nudiflora—"*Pitoli.*"—Bark : no tannin.

"*Maliatah*"—Macaranga species.—Leaves and wood : no tannin.

C.—MORACEÆ—

Ficus species—"*Dumur.*"—Leaves : trace of tannin ; mature bark : no tannin.

Artocarpus chaplasha—"*Lator.*"—Mature bark : trace of tannin ; contains a milky latex.

CIII.—JUGLANDACEÆ—

Engelhardtia spicata—"*Mowa.*"—Leaves; no tannin.

The following species contain much gummy matter.

II.—DILLENIACEÆ—

Dellenia indica—"*Chalta.*"—Twig bark:—gumminess dis

Dillenia pentagyna—"*Tatri.*"—Twig bark.

XIX.—MALVACEÆ—

Bombax malabaricum—"*Simal.*"—Twig bark and mature bark.

XCI.—LAURACEÆ—

Actinodaphne obovata—"*Ranchipat.*"—Twig bark and mature bark.

Litsea sebifera—"*Kauala.*"—Bark.

Litsea polyantha—"*Patmero.*"—Bark.

SECTION III.—INDIVIDUAL DYESTUFFS.

XVI.—TERNSTRŒMIACEÆ—

Schima wallichii—"*Chilauni.*"—Leaves: The leaves of *chilauni* contain a valuable mordant dyestuff, which gives on:—

Tin mordant.—Brilliant yellow, fast to soap;

Alum mordant.—Dull yellowish drab, not useful;

Chrome mordant.—Useful olive-yellow shade.

This dyestuff is suggested for use in admixture with *cutch* in place of the American natural dye "fustic" in the dyeing of khaki shades. The yield of "crystals"—for dyeing, containing 5 per cent. moisture, calculated on the air-dry leaves is 21 per cent. The calculated proportion reckoned on the weight of the wool, of these "crystals" required for a full shade is 4 to 8 per cent., the latter proportion, assuming some loss of colour during concentration.

XXIX.—MELIACEÆ—

Chukrasia tabularis—"*Chikrasi.*"—Young leaves: 30 per cent. of these leaves reckoned on the weight of wool, dyes a very useful olive-green shade with chrome mordant on wool. The colour appears fast both to soap and light.

Yield of "crystals"—for dyeing reckoned on air-dry leaves with 6 per cent. moisture, 43 per cent. The calculated proportion reckoned on the weight of the wool, of these "crystals" required for a full shade, is 12 to 14 per cent.

XXXIX.—SAPINDACEÆ—

Æsculus punduana.—One of the "Indian horse chestnuts".

The twig bark of this, dyes cotton direct in one bath without addition, to a pale salmon shade. The shade on wool is less useful, but as there are so few direct dyes for cotton found in nature, an extract of this product might be valuable and sell well in India. The shade is not however fast to light on cotton, and frequent re-dipping of *puggarees*, etc., would be necessary.

The yield of "crystals"—for dyeing, with 5 per cent. moisture—reckoned on air-dry twig-bark is 33·2 per cent.

LXXXII—ACANTHACEÆ—

Phlogacanthus thyrsiflorus.—The flowers of this shrub yield a beautiful warm golden-brown colour on wool, with tin mordant. Chrome mordant gives a somewhat duller shade of yellow brown. Copper mordant gives an olive

...ium is not useful. Unfortunately, the shade on tin ... action of soap which changes the golden-brown to

...ACEÆ—

...aves of the particular member of this species common in ...a forest turn orange when old. Noticing this peculiarity, ... H. Khan, collected a sample of these leaves for dye tests, ...ed that they were capable of dyeing a fine bright yellow on wool ...addition of tin salt as a mordant. The colour is quite fast to soap.

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